Kathy Malnick (NASA IV&V)

Software Engineering Electronic Handbook

IV&V Annual Workshop September 2012

Overview

- Guidance material to help the NASA workforce implement requirements in NPR 7150.2A and promote best practices
  - Topics of interest
  - All requirements in NPR 7150.2A
- Wiki-based for easier, faster updates and corrections (**first of its kind**)
- Allows developers to easily find and focus on specific information necessary to comply with requirements
- Accessible from the NEN Software Engineering Community of Practice (CoP)

Credible Guidance

- Guidance material developed by a dedicated team that has topic expertise or has researched the material which includes interviews with experts – including IV&V personnel
- References are provided to related material both inside and outside of NASA
- All material is approved for inclusion in the handbook by the Program Executive for Software Engineering in the HQ OCE

Intended Audience

- SW Developers
- SW Managers
- SEPG/SPI Personnel
- SA Personnel, including IV&V
- Project Managers
- Tech Authority Personnel
- Non-Software Engineers who develop software
- Systems Engineers

Relevance for IV&V

- Better quality project artifacts
- Reference for IV&V personnel
  - Understand Agency intentions and expectations for software engineering requirements
  - Compliance matrices for requirements by software class
  - Product maturity map and lifecycle review entrance criteria, material reviewed, and exit criteria
- Opportunity to provide feedback for updates based on experience with projects

Availability

- Now available on NEN Community of Practice
- All material is complete, reviewed and in place for use
- Agency review is nearing completion which will give the handbook its official approval for use

Where is it?

SOFTWARE ENGINEERING

Software Engineering

nen.nasa.gov/software

Ask an Expert
Ask and Find questions from Software Engineer Experts

NASA Software Engineering Handbook (Beta)
NASA Software Guidebook Wiki

Classification Tool (Beta)
Link to software classification guide

NASA Software Process Asset Library (PAL)
Software Process Asset Library

Contact List
Search and Locate Software Engineering Experts from around NASA

Reading Room
Find out what other Software members are reading.

Document Library
Software Documents

Training
Recommended courses for software engineers

Forums
Discuss and read about what is going on in software.

Suggestions
Have an idea or suggestion for the community? We want to hear it!

Links
Software Engineering External Links

SUB COMMUNITIES

Software Architecture Review Board

Demo

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Questions

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NASA ENGINEERING NETWORK

7150.2A Handbook > Home

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Book A. Introduction | Book B. 7150 Requirements Guidance | Book C. Topics | Book D. Label Search | Book E. Utilities

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1. Welcome | 2. SWEHB Introduction | 3. Title Material | 4. References

Welcome from John Kelly

Software Program Executive:
John C. Kelly [434]

Welcome to the NASA Software Engineering Handbook (SWEHB). This wiki based handbook provides users and practitioners with guidance material for implementing the requirements of NPR 7150.2, NASA Software Engineering Requirements. Use of this SWEHB is intended to provide "best in class" guidance for the implementation of safe and reliable software in support of NASA projects. This SWEHB is a key component of the NASA Software Working Group's (SWG) implementation of an Agency wide plan to work toward continuous, sustained software engineering process and product improvements.

The SWG designed this handbook for the community that is involved in the acquisition, management, development, assurance, maintenance, and operations of NASA software. Readers can use it to sharpen their skills in specific areas or suggest valuable guidance for others in the NASA software community. Novice and experienced software team members can use the handbook as an easily accessible reference or manual which captures the broad knowledge base of numerous experts who have extensive experience in all aspects of NASA's software systems.

In this SWEHB you will see information for determining the scope and applicability of the individual requirements from NPR 7150.2. You will also see rationale, implementation guidance, tools used in the development of NASA software, pointers to key lessons learned, and select references for further information.

We have adopted the 'wiki' approach for this version of the handbook to encourage you to submit candidate improvements to the information in this handbook. Your comments, suggestions for improvement, offerings of additional candidate material for the handbook, and identification of errors are solicited to make this a living and ongoing source of useful information. You can use the 'Comments' box on almost any page of the wiki to submit your inputs and responses. The SWG's SWEHB team will review and disposition your comments to enhance the wealth of useful material which is now at the fingertips of NASA's software community.

We hope you find the information provided by many contributing experts, distilled into useful chunks by the SWEHB team, and jointly reviewed by NASA's SWG and NASA's MSSC ** members helpful in your day to day quest for engineering excellence.

* Chartered by the NASA Engineering Management Board and funded by the NASA Headquarters Office of Chief Engineer
** NASA Mission Software Steering Committee

(Contact the SWEHB site admin for resolution of technical difficulties.)

This section contains guidance, rationale, and lists of useful resources and tools related to each and every one of the requirements in NPR 7150.2. You can use the table below or to see the full text of all requirements and links to our guidance on each, follow this link: Full 7150.2A Requirements List.

- newly added (March 6, 2012), **TOTAL # OF SECTIONS RELEASED:** 135

Chapter 1. Introduction

SWE 001-006 Chapter 1 full text (NODIS)

SWE-001 - Effective Date
SWE-002 - Software Engineering Initiative
SWE-003 - Center Improvement Plans
SWE-004 - OCE Benchmarking
SWE-005 - Software Processes
SWE-006 - Agency Software Inventory

Chapter 2. Software Management Requirements

SWE 013-048, 130-134 Chapter 2 full text (NODIS)

SWE-013 - Software Plans
SWE-130 - Develop a software safety plan
SWE-131 - Independent Verification and Validation Project Execution Plan
SWE-014 - Execute Planning
SWE-015 - Cost Estimation
SWE-016 - Software Schedule
SWE-017 - Project and Software Training
SWE-018 - Software Activities Review
SWE-019 - Software Life Cycle
SWE-020 - Software Classification
SWE-132 - Independent Software Classification Assessment
SWE-133 - Software Safety Determination
SWE-021 - Transition to a Higher Class
SWE-022 - Software Assurance
SWE-023 - Software Safety
SWE-134 - Safety Critical Software Requirements
SWE-024 - Plan Tracking

Chapter 3. Software Engineering (Life-Cycle) Requirements

SWE 049-078,135,136 Chapter 3 full text (NODIS)

SWE-049 - Document Software Requirements
SWE-050 - Software Requirements
SWE-051 - Software Requirements Analysis
SWE-052 - Bidirectional Traceability Between Higher Level Requirements and Software Requirements
SWE-053 - Manage Requirements Changes
SWE-054 - Corrective Action for Inconsistencies
SWE-055 - Requirements Validation
SWE-056 - Document Design
SWE-057 - Software Architecture
SWE-058 - Detailed Design
SWE-059 - Bidirectional Traceability Between Software Requirements and Software Design
SWE-060 - Coding Software
SWE-061 - Coding Standards
SWE-135 - Static Analysis
SWE-062 - Unit Test
SWE-063 - Release Version Description
SWE-064 - Bidirectional Traceability Between Software Design and Software Code
SWE-136 - Software Tool Accreditation
SWE-065 - Test Plan, Procedures, Reports
SWE-066 - Perform Testing
SWE-067 - Verify Implementation
SWE-068 - Evaluate Test Results
SWE-069 - Document Defects and Track
SWE-070 - Models, Simulations, Tools
SWE-071 - Update Test Plans and Procedures
SWE-072 - Bidirectional Traceability Between Software Test Procedures and Software Requirements
SWE-073 - Platform or Hi-Fidelity Simulations

Chapter 5. Software Documentation Requirements

SWE 102-119, 138 Chapter 5 full text (NODIS)

SWE-102 - SW Development-Management Plan
SWE-103 - Software CM Plan
SWE-104 - Software Test Plan
SWE-105 - Software Maintenance Plan
SWE-106 - Software Assurance Plan
SWE-107 - SW Training Plan Contents
SWE-108 - Center SW Improvement Plan
SWE-138 - Software Safety Plan Contents
SWE-109 - Software Requirements Specification
SWE-110 - Software Data Dictionary
SWE-111 - Software Design Description
SWE-112 - Interface Design Description
SWE-113 - SW Change Request, Problem Report
SWE-114 - Software Test Procedures
SWE-115 - Software User Manual
SWE-116 - Software Version Description
SWE-117 - Software Metrics Report
SWE-118 - Software Test Report
SWE-119 - Software Documentation Requirements - Software Inspection,Peer Reviews, Inspections

Chapter 6. Tailoring, Engineering Technical Authority, and Compliance Measurement

SWE 120-129, 131, 139-14 Chapter 6 full text (NODIS)

SWE-120 - General Exclusion from Requirements
SWE-121-Document Alternate Requirements
SWE-122 - Technical Authority Appointment
SWE-124 - ETA OCE Compliance

SWE-055 - Requirements Validation

1. The Requirement | 2. Rationale | 3. Guidance | 4. Small Projects | 5. Resources | 6. Lessons Learned

1. Requirements

3.1.2.3 The project shall perform requirements validation to ensure that the software will perform as intended in the customer environment.

1.1 Notes

Requirements validation includes confirmation that the requirements meet the needs and expectations of the customer. Requirement validation is confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled.

1.2 Applicability Across Classes

Class	A_SC	A_NSC	B_SC	B_NSC	C_SC	C_NSC	D_SC	D_NSC	E_SC	E_NSC	F	G	H
Applicable?	✓	✓	✓	✓	✓	✓	✓	✗	✓	✗	✓	✓	✗

Key: A_SC = Class A Software, Safety Critical | A_NSC = Class A Software, Not Safety Critical | ... | ✓ - Applicable | ✗ - Not Applicable

✓[X] - Applicable with details, read above for more | P(C) - P(Center), follow center requirements or procedures

SWE-055 - Requirements Validation

1. The Requirement 2. Rationale 3. Guidance 4. Small Projects 5. Resources 6. Lessons Learned

2. Rationale

Requirements are the basis for a project. They identify the need to be addressed, the behavior of the system, and the constraints under which the problem is to be solved. They also specify the performance of the product to be delivered by a contracted provider of software.

Requirements that accurately describe the need to be solved by the project team need to be defined before the main planning and building activities begin. Validation is one way to ensure the requirements define the need completely, clearly, correctly, and consistently to give the software engineers the best chance to build the correct product.

Validation is a process of evaluating artifacts to ensure that the right behaviors have been defined in the artifacts. The right behaviors adequately describe what the system is supposed to do, what the system is not supposed to do, and what the system is supposed to do under adverse conditions.

Marasco (2007) describes requirements validation as; "making sure everyone understands and agrees on the requirements put forth, and that they are realistic and precise" 012

Other reasons for validating requirements:

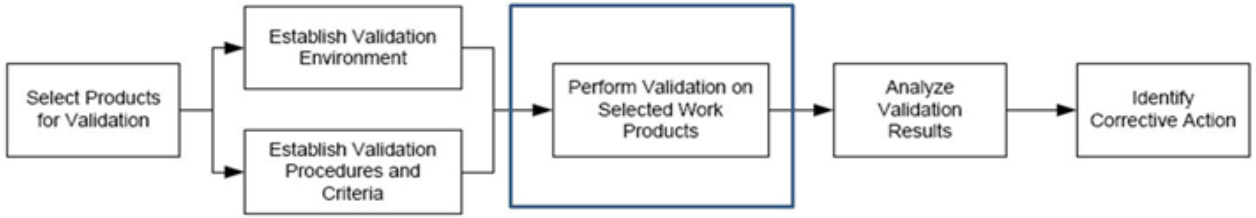
- To ensure customer satisfaction with the end product
- To reduce costs (i.e., get it right the first time)
- To gain confidence that the requirements can be fulfilled for the intended use
- To clarify meaning and expectations

> Per the NASA IV&V Technical Framework 003 document, "The objective of Requirements IV&V is to ensure the system's software requirements are high quality (correct, consistent, complete, accurate, readable, and testable), and will adequately meet the needs of the system and expectations of its customers and users, considering its operational environment under nominal and off-nominal conditions, and that no unintended features are introduced…"

SWE-055 - Requirements Validation

3. Guidance

The basic validation process is shown below with the steps addressed by this requirement highlighted:



1

Validation activities are not to be confused with verification activities as each has a specific goal. Validation is designed to confirm the right system is being produced while verification is designed to confirm the product is being produced correctly.

2

Requirements validation, as used in this requirement, addresses all of the following:

3

- Confirmation of the correctness, completeness, clarity, and consistency of the requirements with stakeholders
- Confirmation that the requirements will be fulfilled by the resulting product
- Confirmation that implied or inherent requirements (e.g., system should do X before Y) are correctly implemented

Validation activities are not performed in an ad hoc manner, but are planned and captured in a validation plan document. The validation plan is typically part of a verification and validation (V&V) plan, a software V&V plan (SVVP), or is included in the Software Management / Development Plan (SMP/SDP).

All requirements need to be validated. Categories include, but are not limited to:

- System requirements (note that systems level validation procedures are described in NPR 7123.1A [041], with guidelines in the NASA Systems Engineering Handbook [273])
- Subsystem requirements
- Safety requirements

Peer review / inspection checklists
Formal review checklists
Analysis procedures
Acceptance test procedures

Samples are included in the Resources section of this guidance, but Center procedures take precedence when conducting requirements validation activities at a particular Center.

A requirements traceability matrix may also be useful to ensure that all requirements are validated. The matrix could include:

- Links to higher-level requirements which identify/define user needs
- A place to record validation methods
- A place to record or reference the validation results

Some common issues related to requirements validation include: [012]

- Confusing management of requirements with validation of requirements
    - Managing requirements will not ensure they are correct
- When using prototyping to validate requirements,
    - Failing to keep the focus on *what* the software is supposed to do
    - Allowing the focus to shift to the *how* the system will look when it is done
- Failing to re-validate requirements as they change during the project life cycle
- Getting stakeholders with different views to agree on a single version of a requirement; interpretation can be troublesome
- When using visual models to bridge the communication gaps among stakeholders, only translating a limited number of requirements into visual models (often due to time or budgetary constraints)
- Failing to link the text to visual models; both are needed for understanding
- Failing to use a formal process to track all versions of the requirements as they change during the project

Additionally, it is important to confirm with stakeholders that their needs and expectations remain adequately and correctly captured by the requirements following resolution of conflicting, impractical and/or unrealizable stakeholder requirements.

While the Software Requirements Review (SRR) addresses more than just "getting the requirements right", the SRR can include that action as part of the review.

See also related requirements in this handbook:

SWE-029	Validation planning
SWE-031	Validation results
SWE-073	Platform or hi-fidelity simulations)
SWE-102	SW development/management plan

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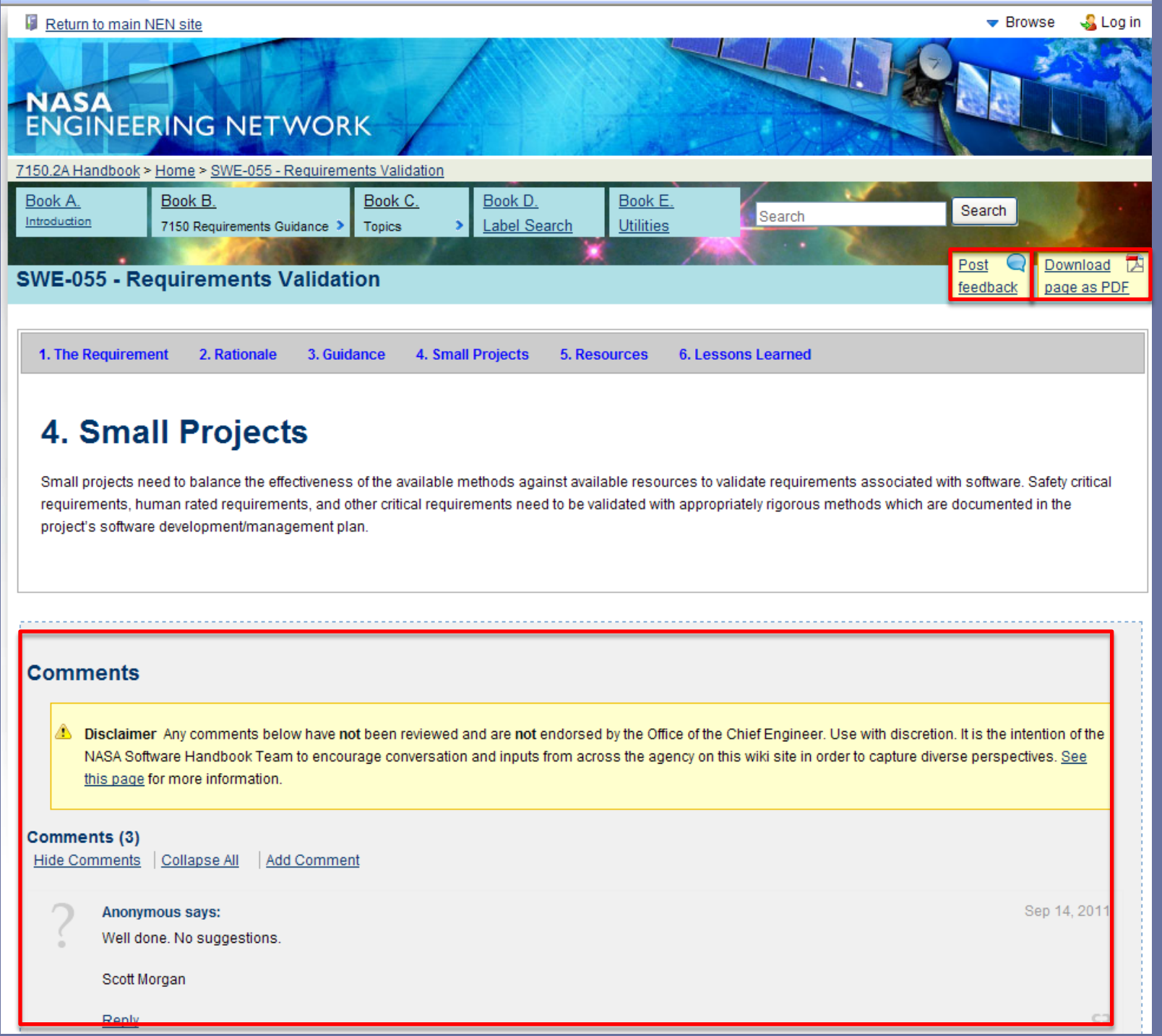
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4. Small Projects
Small projects need to balance the effectiveness of the available methods against available resources to validate requirements associated with software. Safety critical requirements, human rated requirements, and other critical requirements need to be validated with appropriately rigorous methods which are documented in the project's software development/management plan.
Comments
Disclaimer Any comments below have not been reviewed and are not endorsed by the Office of the Chief Engineer. Use with discretion. It is the intention of the NASA Software Handbook Team to encourage conversation and inputs from across the agency on this wiki site in order to capture diverse perspectives. See this page for more information.
Comments (3)
Hide Comments | Collapse All | Add Comment
Anonymous says:
Sep 14, 2011
Well done. No suggestions.
Scott Morgan
Reply

1

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SWE-055 - Requirements Validation

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5. Resources

Click here to view master references table.

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- (SWEREF-041) NASA Systems Engineering Processes and Requirements w/ Change 1 (11/04/09) NPR 7123.1A, NASA Office of the Chief Engineer, 2009.
- (SWEREF-042) "Peer Review Inspection Checklist," R2V0, NASA, 1990.
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- (SWEREF-079) "ISD Inspections, Peer Reviews, and Walkthroughs," 580-SP-055-01, Information Systems Division, NASA Goddard Space Flight Center (GSFC), 2006.
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- (SWEREF-206) Hooks, Ivy F., Farry, Kirstin A., "Customer-Centered Products: Creating Successful Products through Smart Requirements Management," American Management Association, New York, 2001.
- (SWEREF-209) IEEE Standard for Software Verification and Validation IEEE Computer Society, IEEE Std 1012-2004, 2004. This link requires an account on the NASA START (AGCY NTSS) system (http://standards.nasa.gov). Once logged in, users can access Standards Organizations, IEEE and then search to get to authorized copies of IEEE standards.
- (SWEREF-209) IEEE Standard for Software Verification and Validation IEEE Computer Society, IEEE Std 1012-2004, 2004. This link requires an account on the NASA START (AGCY NTSS) system (http://standards.nasa.gov). Once logged in, users can access Standards Organizations, IEEE and then search to get to authorized copies of IEEE standards. Chapter 7
- (SWEREF-219) IEEE Computer Society, "IEEE Standard for Software Reviews and Audits", IEEE Std 1028, 2008. This link requires an account on the NASA START (AGCY NTSS) system (http://standards.nasa.gov). Once logged in, users can access Standards Organizations, IEEE and then search to get to authorized copies of IEEE standards.
- (SWEREF-224) IEEE Computer Society, "Systems and software engineering – Software life cycle processes", ISO/IEC 12207, IEEE Std 12207-2008, 2008.

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- (SWEREF-219) IEEE Computer Society, "IEEE Standard for Software Reviews and Audits", IEEE Std 1028, 2008. This link requires an account on the NASA START (AGCY NTSS) system (http://standards.nasa.gov). Once logged in, users can access Standards Organizations, IEEE and then search to get to authorized copies of IEEE standards.
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- (SWEREF-247) Marasco, Dr. Joe, "The importance of testing software requirements", 2007. In www.techtarget.com. Accessed June 2011 from http://searchsoftwarequality.techtarget.com/news/1275907/The-importance-of-testing-software-requirements. Requires Free Membership to view content.
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- (SWEREF-274) "Safety and Mission Assurance Acronyms, Abbreviations, and Definitions," NASA Technical Standard, NASA-STD 8709.22, 2010.
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- (SWEREF-304) Raja, U.A. (February, 2009). "Empirical Studies of Requirements Validation Techniques." IEEE Computer, control and Communication, 2009. IC$ 2009. 2nd International Conference. Retrieved on February 29, 2012 from http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=04909209. This link may require you to be logged in on your NASA network or to have an account on the NASA START (AGCY NTSS) system (http://standards.nasa.gov). Once logged in, users can access Standards Organizations, IEEE and then search to get to authorized copies of IEEE standards.
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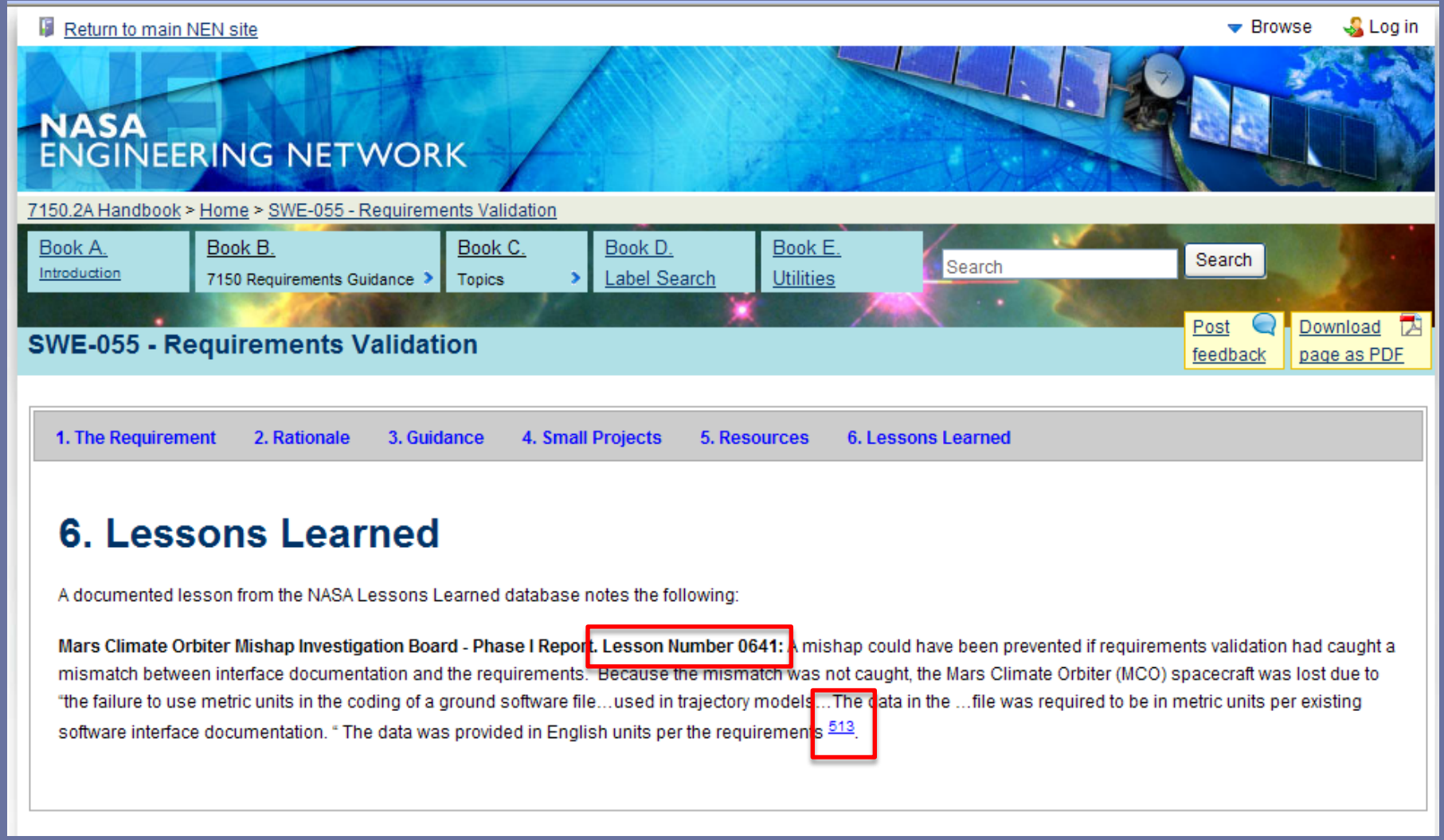
5.1 Tools

Tools relative to this SWE may be found in the table below. You may wish to reference the Tools Table (click here to visit) in this handbook for an evolving list of these and other tools in use at NASA. Note that this table should not be considered all-inclusive, nor is it an endorsement of any particular tool. **Check with your Center to see what tools are available to facilitate compliance with this requirement.**

Tool name	Type	Owner/Source	Link	Description	User
IBM Rhapsody	COTS	IBM Rational	http://www-01.ibm.com/software/awdtools/rhapsody/...	"IBM® Rational® Rhapsody® family provides collaborative design and development for systems engineers and software developers creating real-time or embedded systems and software. Rational Rhapsody helps diverse teams collaborate to understand and elaborate requirements, abstract complexity visually using industry standard languages (UML, SysML, AUTOSAR, DoDAF, MODAF, UPDM), validate functionality early in development, and automate delivery of innovative, high quality products." (NOTE: Several versions are listed on the website for architecture, system engineering requirements analysis, design and model management, simulations to validate requirements and analyze architecture, and code generation. Unsure which versions are used within NASA. Listed requirements are those related to these topics.)	IV&V GSFC ?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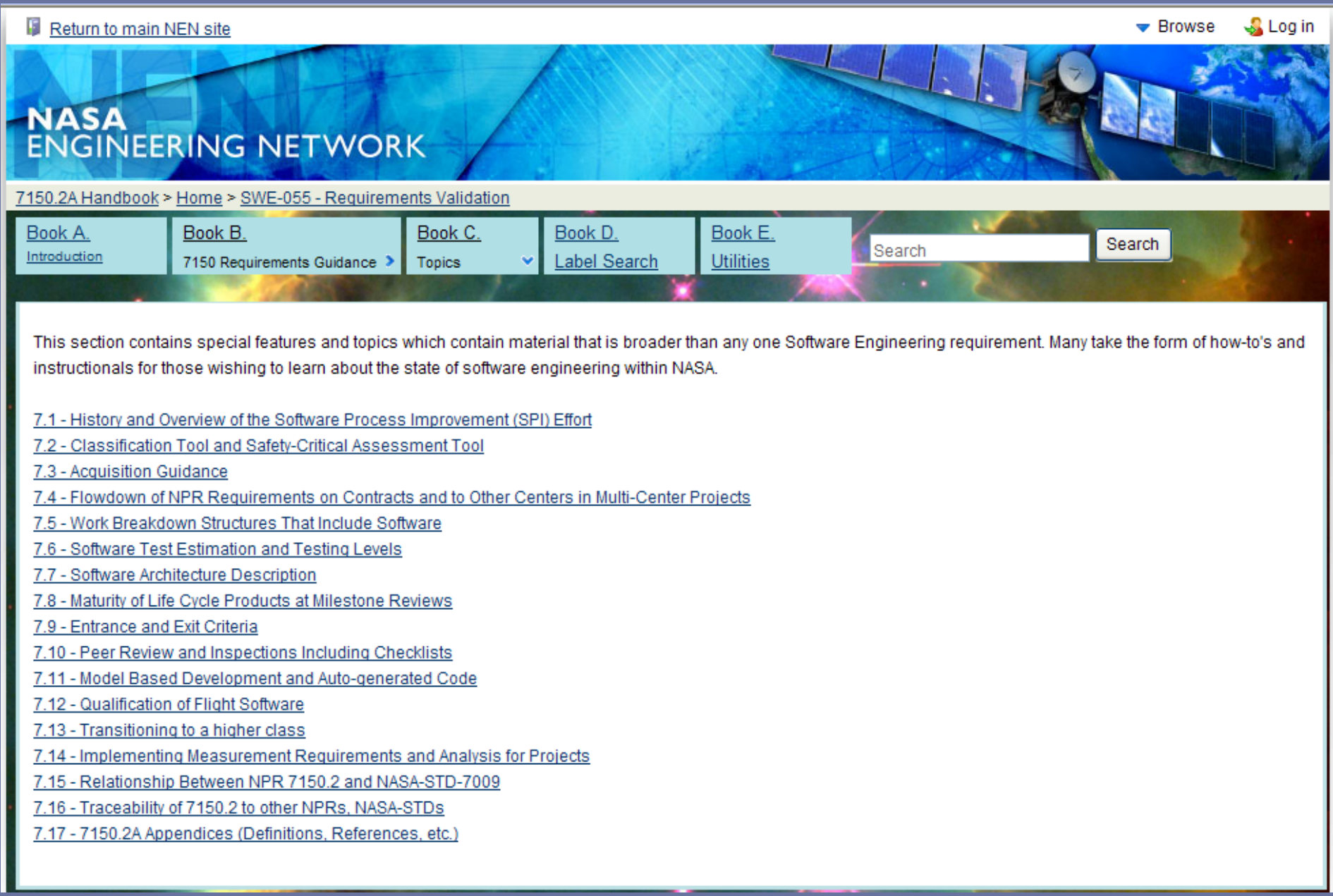
6. Lessons Learned
A documented lesson from the NASA Lessons Learned database notes the following:
Mars Climate Orbiter Mishap Investigation Board - Phase I Report. Lesson Number 0641: A mishap could have been prevented if requirements validation had caught a mismatch between interface documentation and the requirements. Because the mismatch was not caught, the Mars Climate Orbiter (MCO) spacecraft was lost due to "the failure to use metric units in the coding of a ground software file…used in trajectory models…The data in the …file was required to be in metric units per existing software interface documentation. " The data was provided in English units per the requirements 513.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This section contains special features and topics which contain material that is broader than any one Software Engineering requirement. Many take the form of how-to's and instructionals for those wishing to learn about the state of software engineering within NASA.
7.1 - History and Overview of the Software Process Improvement (SPI) Effort
7.2 - Classification Tool and Safety-Critical Assessment Tool
7.3 - Acquisition Guidance
7.4 - Flowdown of NPR Requirements on Contracts and to Other Centers in Multi-Center Projects
7.5 - Work Breakdown Structures That Include Software
7.6 - Software Test Estimation and Testing Levels
7.7 - Software Architecture Description
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7.14 - Implementing Measurement Requirements and Analysis for Projects
7.15 - Relationship Between NPR 7150.2 and NASA-STD-7009
7.16 - Traceability of 7150.2 to other NPRs, NASA-STDs
7.17 - 7150.2A Appendices (Definitions, References, etc.)

7.3 - Acquisition Guidance

1. Purpose

This topic discusses guidance for projects implementing those requirements in NPR 7150.2, NASA Software Engineering Requirements, that address software acquisition. This guidance is intended for all persons responsible for the software acquisition process, from the planning stages through contract closeout. Acquisition may involve procedures and regulations external to the software community, including variations by contract type; therefore, it is important to consult Center guidance and coordinate acquisition activities among the proper stakeholders, including, but not limited to, software engineering, procurement, finance, and contracts.

1.1 Roles

Role	Responsibility
Project Manager	Approve procurement plan.
Software Lead Engineer	Prepare procurement plan; prepare statement of work (SOW) software requirements and software data requirements for the contract; monitor execution of contract; conduct trade studies, engineering analyses.
System Engineer	Conduct trade studies, engineering analyses.
Contracting Officer (CO)	Prepare acquisition approach, prepare solicitation, guide proposal evaluation, prepare contracts, prepare modifications to contracts.
Contracting Officer's Technical Representative (COTR)	Work with CO to plan acquisition approach, prepare SOW, evaluate proposals, determine the technical adequacy of proposed approach, monitor technical implementation.
Software Technical Authority	Before contract release, verify that the SOW includes the complete flowdown of the Agency and Center software requirements [recommended practice].

7.8 - Maturity of Life Cycle Products at Milestone Reviews

This chart summarizes current guidance approved by the NASA Office of the Chief Engineer (OCE) for software engineering life cycle products and their maturity level at the various software project life cycle reviews. This chart serves as guidance only and NASA Center procedures should take precedence for projects at those Centers.

The chart was constructed using the software engineering products from NPR 7150.2, the project life cycle reviews from NPR 7123.1 [041], previous work from the NASA Software Working Group to map products to life cycle reviews, and additional information gathered from these NPRs, NPR 7120-5D (NM 7120-81) [082], and individual NASA Center procedures. Draft versions of the chart were reviewed by the NASA Software Working Group resulting in this chart which represents the current consensus guidance from this collection, collation, and review process.

NPR 7150.2 does include life cycle products which are not included in the chart and there are life cycle reviews which are also not represented in the chart. Insufficient information currently exists or consensus was not reached for those elements which will all be considered for future updates to this chart.

7150.2 Software Life Cycle Products	MCR	SRR	MDR	SDR	PDR	CDR	SIR	TRR	SAR	ORR
Software Development Plan (SDP) / Software Management Plan (SMP)		P	P		B	U				
Software Schedule	D	P	U	U	B	U				
Software Cost Estimate	D	P	U	U	B	U				
Software Configuration Management Plan (SCMP)		P	P		B	U				
Software Test Plans					P	B	U	U		
Software Test Procedures						P		B		
Software Test Reports									F	
Software Maintenance Plan	D	P	P	U	U	U				
Software Assurance Plan(s)		P	P	P	B	U				
Software Safety Plan, if safety-critical s/w		P			B	U				
Software Requirements Specification (SRS)		P			B	U		U		
Requirements on OTS s/w		P			B	U				
Software Data Dictionary					P	B				
Software Design Description (Architectual Design)					B	U		U		
Software Design Description (Detailed Design)					P	B		U		
Interface Design Description					P	B		U		
Software User's Manual (SUM)										B
Records of Continuous Risk Management	P	U	U	U	U	U			U	
Measurement Analysis Results					X	X				
Operational Concepts (part of "Mission Operations Concept" or separate)		P	U		B	U				
Record of trade-off criteria & assessment (make / buy decision)					X	X				
Acceptance Criteria and Conditions					P	B				

Maturity Types Key

F = Final, D = Draft, P = Preliminary, B = Baseline, U = Updated/Updated as required, X = assume complete (final), not explicit in NPRs

Review Types Key

MCR = Mission Concept Review, **SRR** = System Requirements Review, **MDR** = Mission Definition Review, **SDR** = System Definition Review, **PDR** = Preliminary Design Review, **CDR** = Critical Design Review, **SIR** = System Integration Review, **TRR** = Test Readiness Review, **SAR** = System Acceptance Review, **ORR** = Operational Readiness Review

Tag Multi-Select

Multi-Select | Tag Usage | Tag Cloud

Quick Start

This section of the Software Engineering Handbook allows you to select single or multiple labels from the Tag table and see which sections of the handbook have those labels. The multiple search is an AND operation, so any page returned in the search below has all of the labels you have selected.

Please check the boxes of the labels which you wish to search for, and scroll to the bottom to find the Search button. The search results will display just below that. If you do not get any search results, that probably means you have been too restrictive in your search, so checking fewer boxes will ensure you have some results.

Label Table

Role and Discipline

Software systems engineer (Role: Product Development) (SSE)	Software requirements engineer (Role: Product Development) (SRE)	Design (Role: Product Development) (DESIGN)	Coding and Integration (Role: Product Development) (C-I)
Testing and Verification (Role: Product Development) (V-V)	Product Release (Role: Product Development) (PR)	Sustaining Engg & Maintainance (Role: Product Development) (SUS_ENGR)	Project Formulation (Role: Project Management) (PF)
Project Planning (Role: Project Management) (PP)	Project Monitoring & Control (Role: Project Management) (PM-C)	Project Implementation (Role: Project Management) (PI)	Project Closeout (Role: Project Management) (PC)
Configuration Management (Role: Organization Support) (CM)	Measurement and Analysis (Role: Organization Support) (M-A)	Process Engineering (Role: Organization Support) (PE)	Software Assurance (Role: Organization Support) (SA)
Training (Role: Organization Support) (TRAIN)	Planning (Role: Acquisition Role) (ACQ_PLAN)	Insight/Oversight (Role: Acquisition Role) (IN-OVER)	Supplier Monitoring (Role: Acquisition Role) (SM)

Assets

Best-in-Class Example (BICE)	Lessons Learned (LL)	Best Practice (BP)	Tools (TOOL)
Small Project Advice (SMPROJ)			

Responsible Organization

Center Chief Engineer (CCE)	Project Manager (PM)	Center SMA Director and Organization (CSMA)	NASA Chief Safety & Mission Assurance Officer & Organization
Headquarters Chief Engineer and OCE Organization (HQCE)	Software Assurance Manager (SAM)	Center Director (CD)	IV&V Facility Director (IVV)
Software Release Authority (SRA)			

Software Classes

Class A / Safety Critical Software (ASC) ☐	Class A / Not Safety Critical Software (ANSC) ☐	Class B / Safety Critical Software (BSC) ☐	Class B / Not Safety Critical Software (BNSC) ☐
Class C / Safety Critical Software (CSC) ☐	Class C / Not Safety Critical Software (CNSC) ☐	Class D / Safety Critical Software (DSC) ☐	Class D / Not Safety Critical Software (DNSC) ☐
Class E / Safety Critical Software (ESC) ☐	Class E / Not Safety Critical Software (ENSC) ☐	Class F Software (F) ☐	Class G Software (G) ☐
Class H Software (H) ☐			

Documents

Plans (PLAN) ☐	Procedures, lower level, task oriented (PROCEDURE) ☐	Processes, higher level, outcome oriented (PROCESS) ☐	Studies (STUDIES) ☐
Reports (REPORTS) ☐	Analysis (ANALYSIS) ☐	Records (RECORDS) ☐	Product Descriptions (PROD_DESC) ☐

Milestone Reviews

Mission Concept Review (MCR) ☐	System Requirements Review (SRR) ☐	Software Requirements Review (SWRR) ☐	Mission Design Review (MDR) ☐
System Design Review (SDR) ☐	Preliminary Design Review (PDR) ☐	Critical Design Review (CDR) ☐	Production Readiness Review (PRR) ☐
System Integration Review (SIR) ☐	Test Readiness Review (TRR) ☐	System Acceptance Review (SAR) ☐	Operational Readiness Review (ORR) ☐
Flight Readiness Review (FRR) ☐			

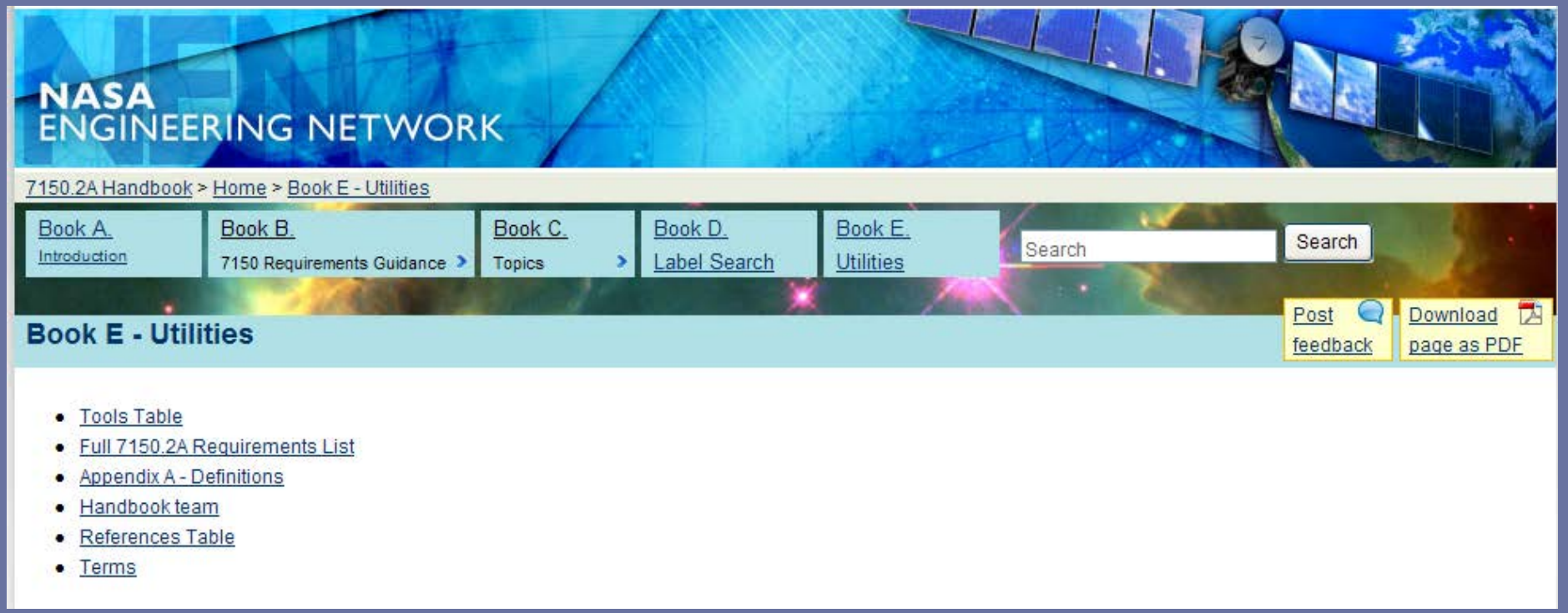
Perform Search

Search | Clear all checkboxes

Search Results

You currently cannot print this list of results, but that feature will be implemented soon. In the meantime, you may be able to copy and paste the resulting table (after you perform a search) into an MS Word document to print or an email to send to someone.

Title
SWE-021 - Transition to a Higher Class
SWE-023 - Software Safety
SWE-026 - Commitment Change Agreements
SWE-028 - Verification Planning
SWE-037 - Software Milestones
SWE-039 - Software Supplier Insight
SWE-049 - Document Software Requirements
SWE-050 - Software Requirements
SWE-051 - Software Requirements Analysis
SWE-052 - Bidirectional Traceability Between Higher Level Requirements and Software Requirements


NASA
ENGINEERING NETWORK
7150.2A Handbook > Home > Book E - Utilities
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Book B.
7150 Requirements Guidance
Book C.
Topics
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Appendix A - Definitions
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Terms

Tools Table

This table includes tools from across the handbook. Note that this table should not be considered all-inclusive, nor is it an endorsement of any particular tool. **Check with your Center to see what tools are available to facilitate compliance with requirements in NPR 7150.2.** If you would like to suggest a tool to be added to this list, please add a comment at the very bottom. Thanks!

add new tool

Tool name	Type	Owner/Source	Link	Description	User	Affiliated SWE
AccuRev	COTS	AccuRev	http://www.accurev.com/accurev.html...	Configuration management, source control	JPL, KSC	[SWE-080]
Action Item Tracking Tool	Downloadable	GSFC	https://nen.nasa.gov/web/software/nasa-software-process-asset-library-pal?p_p_id=webconnector_WAR_we ...	Excel spreadsheet that tracks action items and produces a summary report. Attributes tracked for each action item include ID, Action Item, Assigned To, Priority, Date Opened, Date Due, Date Closed, Days Opened, and Notes.	GSFC	SWE-090, SWE-091
AD hoc Workflows	COTS	Comala Technology Solutions	http://www.adhocworkflows.com/display/WWW/Home...	Ad hoc Workflows helps organizations specify workflows to gain dependable, repeatable and compliant processes.	GRC	SWE-005
Agency Process Asset Library PAL	Process Asset Library	NASA Office of the Chief Engineer	https://nen.nasa.gov/web/software/nasa-software-process-asset-library-pal ...	The NASA Agency software engineering Process Asset Library (Agency PAL) is a resource for the	All Centers	SWE-098, SWE-099

NASA ENGINEERING NETWORK

7150.2A Handbook > Tools > Handbook team

Book A. Introduction | Book B. 7150 Requirements Guidance | Book C. Topics | Book D. Label Search | Book E. Utilities | Search | Search

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Handbook team

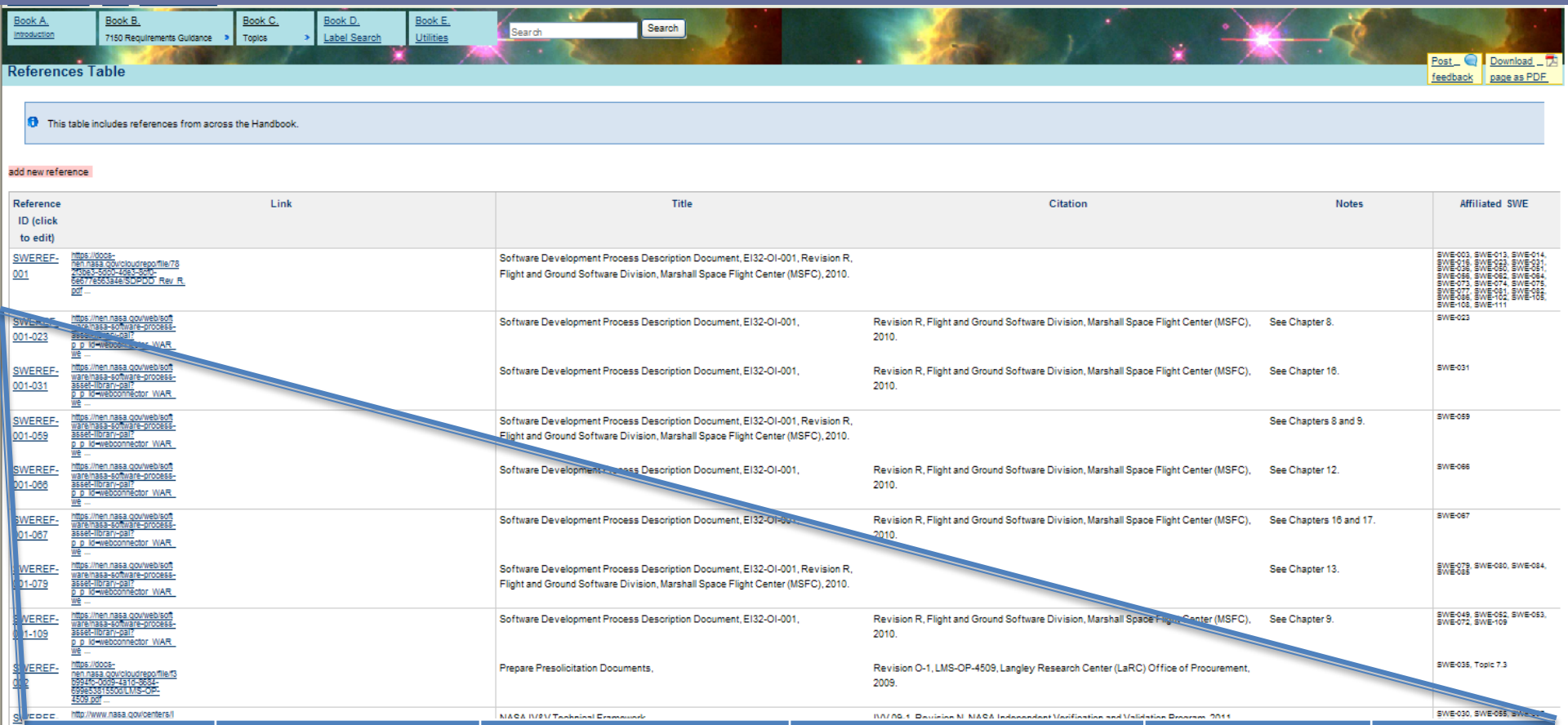
Our Software Engineering Handbook team welcomes you to the handbook website! We hope you find this material helpful and useful as you develop the software products and processes that power our NASA technology, satellites and support systems.

Name	Role
John Kelly	Software Engineering Program Executive
Kevin Carmichael	Team Lead
Jon Verville	Lead Architect
Kathy Malnick Dan Gauntner Dave York	Technical Author
Lee Jackson	Technical Editor
Lisa Dallas Lee Jackson Jon Verville	Web Editor

Welcome from your handbook team!
We are (left to right): Dan Gauntner, Jon Verville, Lee Jackson, Tommy Tayman, Kathy Malnick, and Kevin Carmichael (Lead)
Not pictured: John Kelly, Dave York
Picture taken in front of the new A-3 Test Stand at SSC

Special thanks to

NASA Software Working Group (NSWG) & NASA Software Steering Committee (NSSC) for their review and input on the NASA Software Engineering Handbook.



Reference ID (click to edit)	Link	Title	Citation	Notes	Affiliated SWE
SWEREF-001-023	https://docs-nen.nasa.gov/cloudrepo/file/....	Software Development Process Description Document, EI32-OI-001.	Revision R, Flight and Ground Software Division, Marshall Space Flight Center (MSFC), 2010.	See Chapter 8.	SWE-023

Sources of definitions

Requirement 001

In an email from Dave York on October 14, 2010 regarding the authoritative source of definitions, they should be pulled from the sources in the following order of priority:

1. NPR 7150.2A NASA Software Engineering Requirements, Appendix A, Definitions
2. Aerospace Science & Technology Dictionary - STI - http://www.sti.nasa.gov/nasaonly/AerSpace_DICT/index.htm
   NOTE: The link above is only for those coming from a NASA.gov domain - the public, though trimmed down version is here:
   http://www.sti.nasa.gov/STI-public-homepage.html
3. NPDs (use NODIS to search here)
4. NPRs (use NODIS to search here)
5. STDs (standards.nasa.gov)
6. IEEE (search using this website: IEEE SE VOCAB project at http://pascal.computer.org/sev_display/index.action)
7. Webster's Dictionary

Requirement 002

You shall state the referenced material which the term came from.

add new term

Term	Definition
**	Center Director or the Center Director's designed Engineering Technical Authority (joint Engineering TA & SMA TA if delegated)
abstraction	Abstraction captures and represents only those details about an object that are relevant to the current perspective.
Accredit	The official acceptance of a software development tool, model, or simulation, (including associated data) to use for a specific purpose. (Source: NPR 7150.2A - Appendix A)
Accuracy	The difference between a parameter or variable (or a set of parameters or variables) within a model, simulation, or experiment and the true value or the assumed true value (Definition from source document: NASA-STD-7009, Standard for Models and Simulations.) (Source: NPR 7150.2A - Appendix A)
Acq_Plan	Acquisition Planning. Acq_Plan is also a search tag used in this Software Engineering Handbook to designate a subject relationship with "Acquisition Planning".

Questions